

of a constant-temperature gradient in a distillation column, liquid-level regulators, and a system for the control of salt concentration in an evaporator.

An entirely different but fundamentally important aspect of control systems which involve the services of an operator was discussed by Prof. A. Tustin in a paper entitled "The Nature of the Operator's Response in Manual Control". The operator's response is found to be non-linear and subject to a time delay corresponding to that known to be involved in nerve impulse transmission. A further contribution dealing with the physiological implications of the manual tracking research conducted during the War was made in a paper by Dr. J. A. V. Bates entitled "The Design and Performance of the Human Servo".

At each session of the convention a period was set aside for the discussion of the papers presented. It was noteworthy that despite efforts at standardization of terminology, there are already firmly established differences in nomenclature between process control and the other branches of servo work. The relative reliability of hydraulic and pneumatic systems in relation to electronic systems was a matter which evoked considerable discussion and, in the same connexion, the 'life' of electronic apparatus in control systems generally. The effects of backlash and non-linearity were also discussed.

In a concluding address reviewing the convention, the president of the Institution of Electrical Engineers, Mr. V. Z. de Ferranti, outlined the ground covered by the various contributions and indicated those directions in which he considers the developments of automatic control systems could be turned to good account in meeting the challenge now presented to the whole industrial organisation of Great Britain.

J. GREIG

SCIENTIFIC RESEARCH AND INDUSTRIAL DEVELOPMENT IN SCOTLAND

AT the regional conference on "Research and the Progress of Industry in Scotland", organised by the Federation of British Industries in Glasgow last April, the tendency for the direction of policy, market research and technical research to become concentrated in the south-eastern portion of the United Kingdom even although production might be located where labour was available, sometimes at considerable distances from headquarters, came in for some criticism. Dr. W. M. Cummings, for example, remarked that practically all the research associations sponsored by the Department of Scientific and Industrial Research are situated in that area, and suggested that this may be one reason why Scottish industry has not utilized such research organisations more fully. Dr. Cummings himself urged that the technical colleges might make a greater contribution towards industrial research in Scotland, and pointed to the Joint Research Council established in Manchester as a pattern that might be followed in other industrial areas. From Prof. R. Hay, also of the Royal Technical College, Glasgow, came the further suggestion for a Scottish industrial research institution on the lines of the Mellon Institute; and some dissatisfaction with the present situation also pervades Dr. Wightman's review of the work of Scottish

research institutions issued under the title "Science in Scotland".

What characterizes these criticisms of the present position is, however, the constructive proposals to which they lead, and the evidence of a disposition to explore new methods of dealing with the special situation in Scotland. The need for some definite industrial policy for Scotland is, moreover, the dominant impression left by the report on Industry and Employment in Scotland which has since been issued by the Scottish Office*. The report, indeed, contains remarkable evidence of the energetic way in which local men have tackled Scotland's economic difficulties. In 1933, some 30 per cent of the insured population of Scotland were unemployed, and in July 1939 there were still 10.5 per cent unemployed. The figure for February 1947 was about 6 per cent, the number of unemployed being less than half the corresponding figure for July 1939, and the one and a half million workers were responsible in 1946 for 12.5 per cent of the British output of coal, 38 per cent of the output of new ships, 13.9 per cent of the output of steel ingots and metals for castings, 40 per cent of the output of builder's castings, 45 per cent of the output of locomotives constructed by private builders, 16 per cent of the output of railway wagons, 50 per cent of the output of steam-raising plant and 25 per cent of the output of coalmining machinery.

The importance of these products in the present economic position is obvious; and in addition, the whole of the British output of jute, 90 per cent of its sewing machines, 75 per cent of its oat products, 66 per cent of its kippers and pickled herrings, and 33 per cent of its carpets and of its smoked white fish are provided by Scottish workers. Moreover, there is no general serious shortage of man-power in Scotland, although man-power problems exist in such industries as coal-mining, iron foundries and agriculture. The general picture is one of a very high level of employment, with considerable differences in the level in different industries and districts, shortages of labour in some basic industries, and, on the other hand, some difficult problems of employment, particularly among men and in the outlying areas. This special problem lies mainly in the Development Area, but there are special problems in the Highlands and the islands.

For the rest, the economic problems confronting Scotland are those common to the United Kingdom as a whole, and vigorous measures are being taken to man and develop the basic industries. Scottish engineering is being strengthened and diversified by the introduction of new lines of production as a result both of the War and the Government's policy for the distribution of industry. To provide a fuller diversification of Scottish industry and greater opportunities for employment, the Government, states the report, is attempting to accelerate the building of the new factories already planned and to attract to Scotland, and especially to the Development Area, further industries of the right type, particularly medium engineering, furniture and similar firms which will employ men without at the same time demanding an exceptional degree of physical fitness and strength.

The fourth part of this report, covering technical education and industrial research, as well as general labour questions, is, however, that of main interest to scientific men. The survey of technical education

* Industry and Employment in Scotland. (Cmd. 7125), (Edinburgh and London: H.M. Stationery Office, 1947.) 2s. net.

once again emphasizes that Scotland's basic need is a great increase in the number of local technical colleges, and large and important sections of Scottish industry are ready to take advantage of such provision. Moreover, the demand is not for narrower vocational education but for a type of education which will produce not only a well-trained worker but also an intelligent and responsible worker and citizen. There is also a new attitude towards day release in much of industry; but while many education authorities are ready to meet or encourage demands from industry, the lack of technical colleges or other suitable accommodation restricts their efforts. Again, while it is hoped to announce at an early date the establishment of five regional advisory councils for technical education, based on Aberdeen, Dundee, Edinburgh, Glasgow and Inverness, developments in the central institutions such as the Royal Technical College, Glasgow, have had to be postponed. Production engineering is cited as an example; but, on the other hand, arrangements for the training of industrial designers, including close co-operation with industry, are being discussed with the Scottish Committee of the Council of Industrial Design in relation both to art colleges and to technical colleges. The Scottish Woollen Technical College, with the active co-operation of the Scottish woollen manufacturers, is developing a new broad type of practical training for mill-workers, and at the same time planning developments in higher textile education and research. There has, however, been a marked lack of development in training for management. Scottish industry has not responded well to efforts which the central institutions have made to assist in the training of foremen, and there has been virtually no demand for higher forms of training in management.

An ambitious scheme for industrial research put forward by the Royal Technical College, with the object of establishing the right atmosphere for a first-grade teaching institution and to give Scottish industry all possible assistance in facing its research problem, has recently been approved. Generally, it is observed that while some Scottish firms have admirable laboratories, the volume of industrial research in Scotland is proportionately much less than in certain areas of England, and in spite of the fact that the output of science graduates from Scottish universities is higher in proportion to the population than that of English universities, the report quotes from a survey conducted by the Federation of British Industries which indicates that approximately thirty research workers of graduate standard are employed in England and Wales for one in Scotland, a discrepancy of four to one, after taking into account the population ratio. Many of the industries which give employment to scientific workers are relatively undeveloped in Scotland, and the lack of research workers tends to perpetuate this position. While there are Scottish industries which illustrate the healthy growth produced by a reasonable investment in research, it can be argued that the relative weakness of industrial research in Scotland has militated against the growth of fresh enterprise and the creation of employment in new industries.

The survey suggests that the volume and variety of industrial research in Scotland are not sufficient to ensure healthy industrial development, and that Scottish manufacturers must be encouraged and helped to make the most of the facilities available to them for the application of scientific knowledge

in their industries. In commenting on the work of the Department of Scientific and Industrial Research, both from the point of view of its present research activities in Scotland and the assistance which the Department might give to Scottish industry, the report suggests that the advisory services to be rendered to industry might be given more weight in determining the location of the Department's laboratories. The effectiveness of the assistance given by the laboratory to a firm may be diminished if the laboratory is remote from the firm. Both the framing of the research programme and the utilization of its results depend for efficiency largely on personal contacts. The new office of the Department which has now been opened in Edinburgh should do much to assist Scottish industry in drawing upon the resources of the existing Government facilities for research, and will be in a position to make a realistic assessment of needs for which provision may not at present be made. Among the functions of the new office, for example, are the study of the Scottish industrial position with the view of assisting in the formulation of problems suitable for research, and the examination of the need for additional research facilities as well as for the application of existing facilities as effectively as possible. It will also help to make more readily available in Scotland the large volume of scientific information which exists within the Department; and the office will also take appropriate steps to ensure that discoveries in pure science which may be capable of industrial application are not overlooked, and that opportunities for new developments are not missed.

SOUTH-EASTERN UNION OF SCIENTIFIC SOCIETIES

ANNUAL CONGRESS, 1947

THE fifty-second annual congress of the South-Eastern Union of Scientific Societies was held at Brighton during July 14-19 at the invitation of the Mayor of Brighton and with the co-operation of the Brighton and Hove Archæological and Natural History Societies.

The Mayor welcomed the members at the Royal Pavilion, which had been placed at their disposal by the Corporation, and also entertained them at a *conversazione* where special demonstrations were given on subjects of scientific interest. The Congress Museum was accommodated in the King's Apartments where, throughout the week, an exhibition of drawings and photographs of all the British orchids was displayed by E. J. Bedford. There was also a display of local wild flowers arranged by the Brighton Students Association.

In addition to the public evening meeting, a film display for school children was given in the Pavilion Theatre. The films, which had been prepared by the Central Office of Information for the Ministry of Education, to be used in schools, pointed out the significance of the rocks, antiquities, flora and fauna in our history and economy. Dramatization had rightly been avoided in the preparation, but some processes were demonstrated.

Prof. W. A. F. Balfour-Browne, in delivering his presidential address on "The Possibilities of Natural History", said that, for his purpose, natural history